Appendix I for
US Serial No. 10/633,509
Amendment dated August 9, 2004

IN THE CLAIMS:

1 – 70. (cancelled).

71. (currently amended) A catalyst composition useful in the polymerization of olefins formed by contacting substantially simultaneously in a single reaction zone and in an inert liquid, the components comprising:

a) aluminum compounds selected from at least one aluminum compound represented by the formula

$$Al(R)_a(Q)_b(D)_c$$

wherein

R is a hydrocarbyl group;

Q is a hydrocarbyloxy group;

D is hydrogen or halogen;

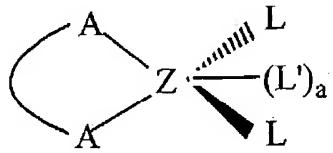
and each a, b, c is an integer of 0-3 provided the sum of a+b+c is 3;

b) an inorganic oxide having from 0.01 to 12 mmole/gram of surface hydroxyl groups; and

c) a precatalyst selected from at least one transition metal compound selected from the group consisting of a bidentate ligand/transition metal complex, a tridentate ligand/transition metal complex and mixtures thereof and wherein the transition metal of said complex is Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, Ti, Zr or Hf;

said components being present in amounts to provide 0.001 to 2.1 mmol of aluminum and from 1 to 1000 μmol of transition metal per gram of inorganic oxide and a mole ratio of aluminum <u>of component a)</u> to transition metal <u>of component c)</u> of from 1:1 to 25:1.

72. (currently amended) The catalyst composition of Claim 71 wherein the precatalyst is a transition metal compound comprising at least one~~is a~~ bidentate ligand/transition metal complex represented by the formula



II

wherein

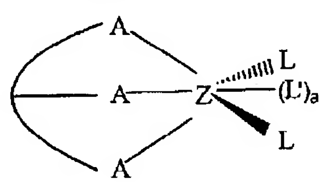
i) each A independently represents an oxygen, sulfur, phosphorus or nitrogen atom of the bidentate ligand;

ii) Z represents a transition metal selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir and Pt in the +2 or +3 oxidation state and Ti, Zr and Hf in the +2, +3 or +4 oxidation state;

iii) each L and L′ independently represents ~~an anionic~~a ligand group selected from the group consisting of hydrogen, halogen, an unsubstituted or a substituted hydrocarbon radical or both L, together with Z, represents a C_3-C_{24} hydrocarbylene metallocyclic structure; and

iv) "a" of $(L')_a$ is an integer of 0, 1 or 2 to provide a neutral transition metal complex.

73. (currently amended) The catalyst composition of Claim 71 wherein the precatalyst is a transition metal compound comprising at least one~~is a~~ tridentate ligand/transition metal complex represented by the formula



III

wherein

i) each A independently represents an oxygen, sulfur, phosphorous or nitrogen atom of the tridentate ligand;

ii) Z represents a transition metal selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir and Pt in the +2 or +3 oxidation state and Ti, Zr, and Hf in the +2, +3 or +4 oxidation state;

iii) each L and L′ independently represents ~~an anionic~~a ligand group selected from the group consisting of hydrogen, halogen, an unsubstituted or a substituted hydrocarbon radical or both L, together with Z represents a C_3-C_{24} hydrocarbylene metallocyclic structure; and

iv) "a" of $(L')_a$ is an integer of 0, 1 or 2 to provide a neutral transition metal complex.

74. (previously presented) The catalyst composition of claim 72 or 73 wherein each A represents a nitrogen atom, each L and L′ is independently a halogen atom, or a hydrocarbyl or mixtures thereof or both L together form a hydrocarbylene metallocyclic group which, with Z, forms a 3 to 7 member ring structure.

75. (previously presented) The catalyst composition of Claim 72 or 73 wherein "a" of the aluminum compound is 1 to 3 and each L of the transition metal compound is a halogen atom.

76. (previously presented) The catalyst composition of Claim 72 or 73 wherein at least one L of the transition metal complex is hydrocarbyl.

77. (previously presented) The catalyst of Claim 71 wherein Z is Ni, Pd, Fe or Co.

78. (previously presented) The catalyst composition of Claim 72 wherein Z is Ni or Pd and each L is independently chlorine, bromine, iodine or a C_1-C_8 alkyl group.

79. (previously presented) The catalyst composition of Claim 73 wherein Z is iron or cobalt and each L is independently chlorine, bromine, iodine or a C_1-C_8 alkyl group.

80. (previously presented) The catalyst composition of Claim 71 wherein "a" of the aluminum compound is 3.

81. (previously presented) The catalyst composition of Claim 72 wherein "a" of the aluminum compound is 3.

82. (previously presented) The catalyst composition of Claim 73 wherein "a" of the aluminum compound is 3.

83. (previously presented) The catalyst composition of Claim 74 wherein "a" of the aluminum compound is 3.

84. (previously presented) The catalyst composition of Claim 71 wherein the transition metal is Fe.

85. (previously presented) The catalyst composition of Claim 72 wherein the transition metal is Fe.

86. (previously presented) The catalyst composition of Claim 73 wherein the transition metal is Fe.

87. (previously presented) The catalyst composition of Claim 80, 81 or 82 wherein the transition metal is Fe.

88. (previously presented) The catalyst composition of Claim 71 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

89. (previously presented) The catalyst composition of Claim 80 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

90. (previously presented) The catalyst composition of Claim 81 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

91. (previously presented) The catalyst composition of Claim 82 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

92. (previously presented) The catalyst composition of Claim 83 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

93. (previously presented) The catalyst composition of Claim 84 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

94. (previously presented) The catalyst composition of Claim 85 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

95. (previously presented) The catalyst composition of Claim 86 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

96. (previously presented) The catalyst composition of Claim 87 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

97. (previously presented) The composition of Claim 71, 80, 81, 82 or 88 wherein the inorganic oxide is silica and the transition metal is Fe.

98. (previously presented) The catalyst composition of Claim 71, 80 or 88 wherein said aluminum compound is present in an amount to provide from about 0.01 to 1.9 mmol of Al per gram of inorganic oxide; said transition metal complex is present in an amount to provide from 5 to 500 moles of transition metal per gram of inorganic oxide and said aluminum to transition metal is in a molar ratio of 1:1 to 20:1.

99. (previously presented) The catalyst composition of Claim 97 wherein said aluminum compound is present in an amount to provide from about 0.01 to 1.9 mmol of Al per gram of inorganic oxide; said transition metal complex is present in an amount to provide from 5 to 500 moles of transition metal per gram of inorganic oxide and said aluminum to transition metal is in a molar ratio of 1:1 to 20:1.

100. (previously presented) The catalyst composition of Claim 71, 72, 73, 77, 78, 79, 80, 81, 82, 86, 88, 89, 90 or 91 wherein the components are sequentially introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

101. (previously presented) The catalyst composition of Claim 74 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

102. (previously presented) The catalyst composition of Claim 75 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

103. (previously presented) The catalyst composition of Claim 76 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

104. (previously presented) The catalyst composition of Claim 83 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

105. (previously presented) The catalyst composition of Claim 84 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

106. (previously presented) The catalyst composition of Claim 85 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

107. (previously presented) The catalyst composition of Claim 92 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

108. (previously presented) The catalyst composition of Claim 93 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

109. (previously presented) The catalyst composition of Claim 94 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

110. (previously presented) The catalyst composition of Claim 97 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

111. (previously presented) The catalyst composition of Claim 71, 72, 73, 77, 78, 79, 80, 81, 82, 86, 88, 89, 90 or 91 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

112. (previously presented) The catalyst composition of Claim 74 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

113. (previously presented) The catalyst composition of Claim 75 wherein components a), b) and c) are concurrently introduced into the inert liquid and

maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

114. (previously presented) The catalyst composition of Claim 83 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

115. (previously presented) The catalyst composition of Claim 84 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

116. (previously presented) The catalyst composition of Claim 85 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

117. (previously presented) The catalyst composition of Claim 92 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

118. (previously presented) The catalyst composition of Claim 93 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

119. (previously presented) The catalyst composition of Claim 94 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

120. (previously presented) The catalyst composition of Claim 97 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

121. (previously presented) The catalyst composition of Claim 71, 72, 73, 77, 78, 79, 80, 81, 82, 86, 88, 89, 90 or 91 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

122. (previously presented) The catalyst composition of Claim 74 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

123. (previously presented) The catalyst composition of Claim 75 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

124. (previously presented) The catalyst composition of Claim 76 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

125. (previously presented) The catalyst composition of Claim 83 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

126. (previously presented) The catalyst composition of Claim 84 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

127. (previously presented) The catalyst composition of Claim 85 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

128. (previously presented) The catalyst composition of Claim 92 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

129. (previously presented) The catalyst composition of Claim 93 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

130. (previously presented) The catalyst composition of Claim 94 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

131. (previously presented) The catalyst composition of Claim 97 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

132. (previously presented) The catalyst composition of Claim 84, 85 or 86 wherein "a" of the aluminum compound is 3.

133. (previously presented) A heterogeneous catalyst composition useful in the polymerization of olefins comprising a mixture of:

a) aluminum compounds selected from at least one aluminum compound represented by the formula:

$$Al(R)_a(Q)_b(D)_c$$

wherein

R is a hydrocarbyl group;

Q is a hydrocarbyloxy group;

D is hydrogen or halogen;

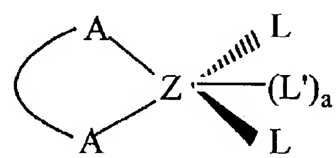
and each a, b, c is an integer of 0-3 provided the sum of a+b+c is 3;

b) an inorganic oxide having from 0.01 to 12 mmole/gram of surface hydroxyl groups; and

c) a precatalyst selected from at least one transition metal compound selected from the group consisting of a bidentate ligand/ transition metal complex , a tridentate ligand/transition metal complex and mixtures thereof and wherein the transition metal of said complex is Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, Ti, Zr or Hf;

said components being present in amounts to provide 0.001 to 2.1 mmol of aluminum and from 1 to 1000 μmol of transition metal per gram of inorganic oxide and a mole ratio of aluminum to transition metal of from 1:1 to 25:1.

134. (currently amended) The catalyst composition of Claim 133 wherein the transition metal compound is a bidentate ligand/transition metal complex represented by the formula



II

wherein

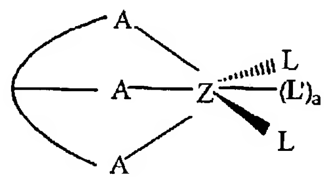
i) each A independently represents an oxygen, sulfur, phosphorus or nitrogen atom of the bidentate ligand;

ii) Z represents a transition metal selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir and Pt in the +2 or +3 oxidation state and Ti, Zr and Hf in the +2, +3 or +4 oxidation state;

iii) each L and L' independently represents ~~an anionic~~a ligand group selected from the group consisting of hydrogen, halogen, an unsubstituted or a substituted hydrocarbon radical or both L, together with Z, represents a C_3-C_{24} hydrocarbylene metallocyclic structure; and

iv) "a" of $(L')_a$ is an integer of 0, 1 or 2 to provide a neutral transition metal complex.

135. (currently amended) The catalyst composition of Claim 133 wherein the transition metal compound is a tridentate ligand/transition metal complex represented by the formula



III

wherein

i) each A independently represents an oxygen, sulfur, phosphorous or nitrogen atom of a tridentate ligand;

ii) Z represents a transition metal selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir and Pt in the +2 or +3 oxidation state and Ti, Zr, and Hf in the +2, +3 or +4 oxidation state;

iii) each L and L′ independently represents ~~an anionic~~a ligand group selected from the group consisting of hydrogen, halogen, an unsubstituted or a substituted hydrocarbon radical or both L, together with Z represents a C_3-C_{24} hydrocarbylene metallocyclic structure; and

iv) "a" of $(L')_a$ is an integer of 0, 1 or 2 to provide a neutral transition metal complex.

136. (previously presented) The catalyst composition of claim 134 or 135 wherein each A represents a nitrogen atom, each L and L′ is independently a halogen atom, or a hydrocarbyl or mixtures thereof or both L together form a hydrocarbylene metallocyclic group which, with Z, forms a 3 to 7 member ring structure.

137. (previously presented) The catalyst composition of Claim 134 or 135 wherein

"a" of the aluminum compound is 1 to 3 and each L of the transition metal compound is a halogen atom.

138. (previously presented) The catalyst composition of Claim 134 or 135 wherein at least one L of the transition metal complex is a hydrocarbyl.

139. (previously presented) The catalyst of Claim 136 wherein Z is Ni, Pd, Fe or Co.

140. (previously presented) The catalyst composition of Claim 134 wherein Z is Ni or Pd and each L is independently a chlorine, bromine, iodine or a C_1-C_8 alkyl group.

141. (previously presented) The catalyst composition of Claim 135 wherein Z is iron or cobalt and each L is independently a chlorine, bromine, iodine or a C_1-C_8 alkyl group.

142. (previously presented) The catalyst composition of Claim 133 wherein "a" of the aluminum compound is 3.

143. (previously presented) The catalyst composition of Claim 134 wherein "a" of the aluminum compound is 3.

144. (previously presented) The catalyst composition of Claim 135 wherein "a" of the aluminum compound is 3.

145. (previously presented) The catalyst composition of Claim 136 wherein "a" of the aluminum compound is 3.

146. (previously presented) The catalyst composition of Claim133 wherein the transition metal is Fe.

147. (previously presented) The catalyst composition of Claim 134 wherein the transition metal is Fe.

148. (previously presented) The catalyst composition of Claim 135 wherein the transition metal is Fe.

149. (previously presented) The catalyst composition of Claim 142, 143 or 144 wherein the transition metal is Fe.

150. (previously presented) The catalyst composition of Claim 133 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

151. (previously presented) The catalyst composition of Claim 142 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

152. (previously presented) The catalyst composition of Claim 143 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

153. (previously presented) The catalyst composition of Claim 144 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

154. (previously presented) The catalyst composition of Claim 145 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

155. (previously presented) The catalyst composition of Claim 146 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

156. (previously presented) The catalyst composition of Claim 147 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

157. (previously presented) The catalyst composition of Claim 148 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

158. (previously presented) The catalyst composition of Claim 149 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m^2/g.

159. (previously presented) The catalyst composition of Claim 133, 142, 143, 144 or 150 wherein the inorganic oxide is silica and the transition metal is Fe.

160. (previously presented) The catalyst composition of Claim 133, 142, or 150 wherein said aluminum compound is present in an amount to provide from about 0.01 to 1.9 mmol of Al per gram of inorganic oxide; said transition metal complex is present in an amount to provide from 5 to 500 moles of transition metal per gram of inorganic oxide and said aluminum to transition metal is in a molar ratio of 1:1 to 20:1.

161. (previously presented) The catalyst composition of Claim 159 wherein said aluminum compound is present in an amount to provide from about 0.01 to 1.9 mmol of Al per gram of inorganic oxide; said transition metal complex is present in an amount to provide from 5 to 500 moles of transition metal per gram of inorganic oxide and said aluminum to transition metal is in a molar ratio of 1:1 to 20:1.

162. (previously presented) A process for forming a heterogeneous catalyst useful in the polymerization of olefins comprising contacting substantially simultaneously in a single reaction zone having an inert liquid, the components comprising:

a) aluminum compounds selected from at least one aluminum compound represented by the formula

$$Al(R)_a(Q)_b(D)_c$$

wherein

R is a hydrocarbyl group;

Q is a hydrocarbyloxy group;

D is hydrogen or halogen; and

each a, b, c is an integer of 0-3 provided the sum of a+b+c is 3;

b) an inorganic oxide having from 0.01 to 12 mmole/gram of surface hydroxyl groups; and

c) a precatalyst selected from at least one transition metal compound selected from the group consisting of a bidentate ligand/transition metal complex, tridentate ligand/transition metal complex and mixtures thereof and wherein said transition metal is selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, Ti, Zr and Hf;

said components being present in amounts to provide 0.001 to 2.1 mmol of aluminum and from 1 to 1000 μmol of transition metal per gram of inorganic oxide and a mole ratio of aluminum to transition metal of from 1:1 to 25:1.

163. (currently amended) The process of Claim 162 wherein the components a), b) and c) are ~~contacted substantially simultaneously~~concurrently introduced into the inert liquid and maintained therein at a temperature of from 0° to 50 °C and atmospheric pressure.

164. (previously presented) The process of Claim 162 or 163 wherein the transition metal is Fe.

165. (previously presented) The process of Claim 162 or 163 wherein the inorganic oxide is silica.

166. (previously presented) The process of Claim 165 wherein the transition metal is Fe.

167. (previously presented) The process of Claim 166 wherein "a" of the aluminum compound is 3.

168. (new) The process of Claim 162 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.